

# Grade 6–8

# Life Science

# Item Specifications

Updated January 2021 (item stems)



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# Introduction

In 2014 Missouri legislators passed House Bill 1490, mandating the development of the Missouri Learning Expectations. In April of 2016, these Missouri Learning Expectations were adopted by the State Board of Education. Groups of Missouri educators from across the state collaborated to create the documents necessary to support the implementation of these expectations.

One of the documents developed is the item specification document, which includes all Missouri grade level/course expectations arranged by domains/strands. It defines what could be measured on a variety of assessments. The document serves as the foundation of the assessment development process.

Although teachers may use this document to provide clarity to the expectations, these specifications are intended for summative, benchmark, and large-scale assessment purposes.

Components of the item specifications include:

**Expectation Unwrapped** breaks down a list of clearly delineated content and skills the students are expected to know and be able to do upon mastery of the Expectation.

**Depth of Knowledge (DOK) Ceiling** indicates the highest level of cognitive complexity that would typically be assessed on a large scale assessment. The DOK ceiling is not intended to limit the complexity one might reach in classroom instruction.

**Item Format** indicates the types of test questions used in large scale assessment. For each expectation, the item format specifies the type best suited for that particular expectation.

**Content Limits/Assessment Boundaries** are parameters that item writers should consider when developing a large scale assessment. For example, some expectations should not be assessed on a large scale assessment but are better suited for local assessment.

**Sample stems** are examples that address the specific elements of each expectation and address varying DOK levels. The sample stems provided in this document are in no way intended to limit the depth and breadth of possible item stems. The expectation should be assessed in a variety of ways.

**Possible Evidence** indicates observable methods in which a student can show understanding of the expectations.

**Stimulus Materials** defines types of stimulus materials that can be used in the item stems.

Life Sciences		6-8.LS1.A.1
Core Idea Component MLS	<b>From Molecules to Organisms: Structure and Processes</b>  <b>Structure and Function</b>  Provide evidence that organisms (unicellular and multicellular) are made of cells and that a single cell must carry out all of the basic functions of life.	
<b><u>Expectation Unwrapped</u></b>  [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Planning and Carrying out Investigations</b> <ul style="list-style-type: none"> <li>Conduct an investigation to produce data to serve as the basis for evidence that meets the goals of an investigation.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Structure and Function</b> <ul style="list-style-type: none"> <li>All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Scale, Proportion, and Quantity</b> <ul style="list-style-type: none"> <li>Phenomena that can be observed at one scale may not be observable at another scale.</li> </ul> <b>The interdependence of Science, Engineering, and Technology</b> <ul style="list-style-type: none"> <li>Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.</li> </ul>		<b><u>DOK Ceiling</u></b> 3  <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced
<b><u>Content Limits/Assessment Boundaries</u></b> <ul style="list-style-type: none"> <li>Tasks should not include the following:               <ul style="list-style-type: none"> <li>Organelle function</li> <li>Chemical interactions (e.g., Krebs Cycle)</li> <li>Microscopy skills</li> </ul> </li> </ul>		<b><u>Sample Stems</u></b>  A student looked at a sample of pond water under a microscope. Below is a picture of what the student observed.

- Specific knowledge of vocabulary (e.g., “having kids” means “reproduction”)

### Possible Evidence

- Students will
  - describe the presence or absence of cells in living and nonliving things.
  - compare and contrast living and nonliving things at a microscopic level.
  - describe part of a living thing that is not made up of cells.
  - use of models to differentiate between a cell and atom.
  - describe the functions of living things (e.g., reproduction, growth, response).



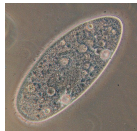
### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings



1. a. Is the object living or non-living  
b. Provide two pieces of evidence from the photo to support your answer to part A.
2. The photo was taken at 30X power. What would happen if we moved the view to 100X power?
3. What additional evidence would be available at 100X power?

Complete the chart below.

Organism	Unicellular	Multicellular
 Bacteria		
 Grass		
 Paramecium		

Life Sciences		6-8.LS1.A.2
Core Idea Component MLS	<b>From Molecules to Organisms: Structure and Processes</b>  <b>Structure and Function</b>  Develop and use a model to describe the function of a cell as a whole and ways parts of the cells contribute to that function.	
<u><b>Expectation Unwrapped</b></u>  [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.]  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Developing and Using Models</b> <ul style="list-style-type: none"> <li>Develop and use a model to describe phenomena.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Structure and Function</b> <ul style="list-style-type: none"> <li>Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Structure and Function</b> <ul style="list-style-type: none"> <li>Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine function.</li> </ul>		<u><b>DOK Ceiling</b></u> 3  <u><b>Item Format</b></u> Selected Response Constructed Response Technology Enhanced
<u><b>Content Limits/Assessment Boundaries</b></u> <ul style="list-style-type: none"> <li>Tasks should not include the following:               <ul style="list-style-type: none"> <li>Cell parts and functions that are not in the clarification statement</li> <li>Biochemical functions (e.g., enzymes, specific cycles) of cells or cell parts</li> <li>Chemical equations or processes of photosynthesis or cellular respiration</li> <li>Labeling of cellular diagrams or models</li> </ul> </li> </ul>		<u><b>Sample Stems</b></u>  Your teacher has potted plants near a swimming pool. At the beginning of the summer, the teacher asks her teenage child to water the plants. After a few weeks, the child noticed the plants are looking very droopy. The teacher asks her child if they are indeed watering the plants

**Possible Evidence**

- When developing and using a model, students will
  - use brief responses and/or models to show how a cell controls what enters and leaves the cell in order to maintain the cell's internal processes (e.g., homeostasis) which need energy.
  - identify the key differences between plant and animal cells based on structure and function (e.g., cell walls and chloroplasts).
  - show the movement of molecules through the cell membrane.
  - describe the purpose of organelles, not how the organelles achieve the purpose (e.g., cellular respiration occurs in the mitochondria, photosynthesis occurs in the chloroplast).

**Stimulus Materials**

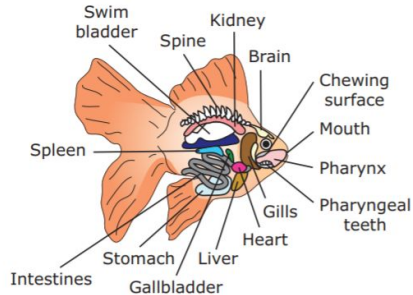
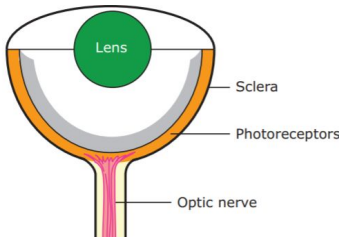
Graphic organizers, diagrams, graphs, data tables, drawings

as requested. The child replies, "Yes. I fill the bucket with water from the pool and water each plant as you have asked."

1. Why are the plants looking droopy?
2. If we were to look at a sample of the plant's cells under a microscope, how might the cells look? Develop a model to describe a cells appearance.
3. What environmental properties constrain behaviors of structures in the cellular system?

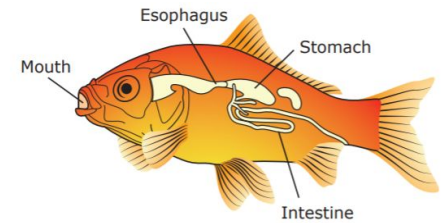
Life Sciences		6-8.LS1.A.3
Core Idea Component MLS	<b>From Molecules to Organisms: Structure and Processes</b>  <b>Structure and Function</b>  Develop an argument supported by evidence for how multicellular organisms are organized by varying levels of complexity: cells, tissues, organs, and organ systems.	
<p align="center"><b><u>Expectation Unwrapped</u></b></p> <p>[Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.]</p> <p><b><u>SCIENCE AND ENGINEERING PRACTICES</u></b></p> <p><b>Engaging in Argument from Evidence</b></p> <ul style="list-style-type: none"> <li>Use oral and written arguments supported by evidence to support or refute an explanation or a model for a phenomenon.</li> </ul> <p><b><u>DISCIPLINARY CORE IDEAS</u></b></p> <p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.</li> </ul> <p><b><u>CROSCUTTING CONCEPTS</u></b></p> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>Systems may interact with other systems; they may have subsystems and be a part of larger complex systems.</li> </ul> <p><b>Science Is a Human Endeavor</b></p> <ul style="list-style-type: none"> <li>Scientists and engineers are guided by habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.</li> </ul>		<p align="center"><b><u>DOK Ceiling</u></b></p> <p align="center">3</p>
		<p align="center"><b><u>Item Format</u></b></p> <p>Selected Response Constructed Response Technology Enhanced</p>



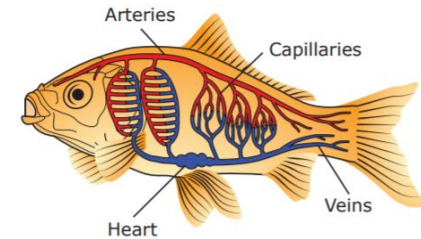
<p style="text-align: center;"><b><u>Content Limits/Assessment Boundaries</u></b></p> <ul style="list-style-type: none"> <li>• Tasks should not include the following: <ul style="list-style-type: none"> <li>○ Individual structures and their functions</li> <li>○ Recall of parts of body systems (i.e., the circulatory, excretory, digestive, respiratory, muscular, and nervous systems)</li> <li>○ Labeling a diagram/model</li> </ul> </li> <li>• All evidence for arguments must be provided.</li> </ul>	<p style="text-align: center;"><b><u>Sample Stems</u></b></p> <p>A student puts flakes of food in the class aquarium. A goldfish in the aquarium immediately changes the direction it had been swimming, moves towards the surface of the aquarium, and eats the food. The student looks up a diagram of goldfish and learns they have the organs shown in Figure 1. They note that many of the fish’s organ systems are similar to that of a human’s.</p>
<p style="text-align: center;"><b><u>Possible Evidence</u></b></p> <ul style="list-style-type: none"> <li>• When engaging in an argument from evidence, students should reason about the following: <ul style="list-style-type: none"> <li>○ Every scale of body function (e.g., cells, tissues, organs, organ systems) is composed of systems of interacting components</li> <li>○ Organs are composed of interacting tissues. Each tissue is made up of specialized cells. These interactions at the cellular and tissue levels enable the organs to carry out specific functions.</li> <li>○ A body is a system of specialized organs that interact with each other and their subsystems to carry out the functions necessary for life.</li> </ul> </li> </ul>	<p><b>Figure 1: Internal Goldfish Structures</b></p>  <p>This diagram shows a cross-section of a goldfish with various internal organs labeled. On the left side, labels include: Swim bladder, Spleen, Intestines, Stomach, and Gallbladder. On the right side, labels include: Kidney, Spine, Brain, Chewing surface, Mouth, Pharynx, Pharyngeal teeth, Gills, Heart, Liver, and Spleen.</p>
<p style="text-align: center;"><b><u>Stimulus Materials</u></b></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>	<p>The goldfish sees the food. Goldfish have photoreceptors at the back of the eye that receive light and transfer that light to the optic nerve which runs from the back of the eye to the brain. The brain is connected to the spine that houses the spinal nerve cord. These structures are shown in Figure 2.</p> <p><b>Figure 2: Eye Structures in Goldfish</b></p>  <p>This diagram shows a cross-section of a goldfish's eye. Labels include: Lens (a green circle in the center), Sclera (the outer white layer), Photoreceptors (a layer of cells at the back of the eye), and Optic nerve (a pink structure extending from the back of the eye).</p>

Figures 3 and 4 show the goldfish digestive and circulatory systems.

**Figure 3: Goldfish Digestive System**



**Figure 4: Goldfish Circulatory System**



1. A student explains that, similar to humans, individual goldfish organ systems must work together for the cells to receive energy from the food. They also argue that organs within those systems are made up of multiple interacting tissues that help them complete their function.
  - a. Identify whether the student's explanation is correct or incorrect.
  - b. Support your answer to Part A with evidence.
  - c. Describe the function of the tissue making up one of the organs in the system.

Life Sciences		6-8.LS1.A.4
<b>Core Idea Component MLS</b>	<b>From Molecules to Organisms: Structure and Processes</b>  <b>Structure and Function</b>  Present evidence that body systems interact to carry out key body functions, including providing nutrients and oxygen to cells, removing carbon dioxide and waste from cells and the body, controlling body motion/activity and coordination, and protecting the body.	
<u><b>Expectation Unwrapped</b></u>		<u><b>DOK Ceiling</b></u> 3
<u><b>SCIENCE AND ENGINEERING PRACTICES</b></u> <b>Engaging in Argument from Evidence</b> <ul style="list-style-type: none"> <li>Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.</li> </ul> <u><b>DISCIPLINARY CORE IDEAS</b></u> <b>Structure and Function</b> <ul style="list-style-type: none"> <li>In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.</li> </ul> <u><b>CROSSCUTTING CONCEPTS</b></u> <b>Systems and System Models</b> <ul style="list-style-type: none"> <li>Systems may interact with other systems; they may have subsystems and be a part of larger complex systems.</li> </ul> <b>Science Is a Human Endeavor</b> <ul style="list-style-type: none"> <li>Scientists and engineers are guided by habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.</li> </ul>		<u><b>Item Format</b></u>  Selected Response Constructed Response Technology Enhanced
<u><b>Content Limits/Assessment Boundaries</b></u>		<u><b>Sample Stems</b></u>
<ul style="list-style-type: none"> <li>Tasks should not include the following: <ul style="list-style-type: none"> <li>Recall of parts of body systems (circulatory, excretory, digestive, respiratory, muscular, and nervous systems)</li> <li>Specific nutrients the body requires</li> <li>Mechanical and chemical digestion</li> </ul> </li> </ul>		A student puts flakes of food in the class aquarium. A goldfish in the aquarium immediately changes the direction it had been swimming, moves towards the surface of the aquarium, and eats the food.

- Labeling a diagram/model
- All evidence for arguments must be provided.

### Possible Evidence

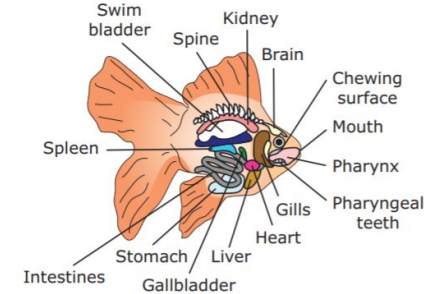
- When engaging in an argument from evidence, students should reason about the following:
  - Every scale of body function (e.g., cells, tissues, organs, organ systems) is composed of systems of interacting components.
  - A body is a system of specialized organs that interact with each other and their subsystems to carry out the functions necessary for life.
- Students should identify reasons different organs can work together to carry out complex function (e.g., the heart contains muscle, connective, and epithelial tissues that allow the heart to receive and pump blood).

### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

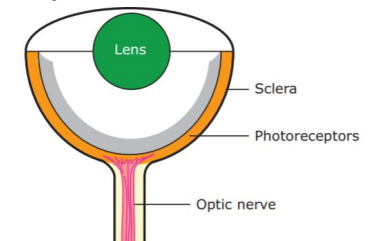
The student looks up a diagram of goldfish and learns they have the organs shown in Figure 1. They note that many of the fish's organ systems are similar to that of a human's.

**Figure 1: Internal Goldfish Structures**



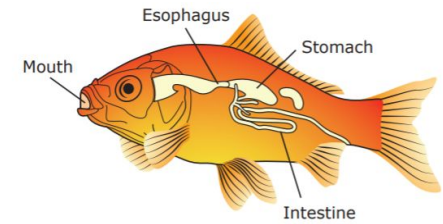
The goldfish sees the food. Goldfish have photoreceptors at the back of the eye that receive light and transfer that light to the optic nerve which runs from the back of the eye to the brain. The brain is connected to the spine that houses the spinal nerve cord. These structures are shown in Figure 2.

**Figure 2: Eye Structures in Goldfish**

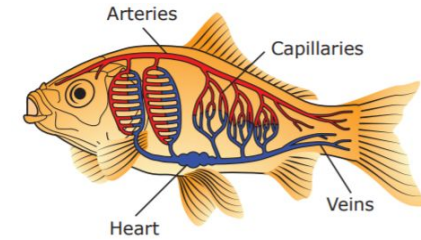


Figures 3 and 4 show the goldfish digestive and circulatory systems.

**Figure 3: Goldfish Digestive System**



**Figure 4: Goldfish Circulatory System**



1. The student watches the goldfish and sees there is evidence of some body systems interacting. Place **two** check marks in each row to select the body systems that are interacting.

Evidence / System	Nervous System	Digestive System	Circulatory System	Muscular System
Fish engages muscles to change direction.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The fish engages muscles and salivary glands to eat food.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Life Sciences		6-8.LS1.B.1
Core Idea Component MLS	<b>From Molecules to Organisms: Structure and Processes</b>  <b>Growth and Development of Organisms</b>  Construct an explanation for how characteristic animal behaviors as well as specialized plant structures affect the probability of successful reproduction of animals and plants respectively.	
<b><u>Expectation Unwrapped</u></b>  [Clarification Statement: Examples of animal behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of plant behaviors that affect the probability of plant reproduction could include transferring pollen or seeds; and, creating conditions for seed germination and growth. Examples of plant structures that affect the probability of plant reproduction could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Engaging in Argument from Evidence</b> <ul style="list-style-type: none"> <li>Use an oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Growth and Development of Organisms</b> <ul style="list-style-type: none"> <li>Animals engage in characteristic behaviors that increase the odds of reproduction.</li> <li>Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features of reproduction.</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Phenomena may have more than one cause, and some cause and effect relationships in systems can be described only by using probability.</li> </ul>		<b><u>DOK Ceiling</u></b> 3  <b><u>Item Format</u></b>  Selected Response Constructed Response Technology Enhanced

### Content Limits/Assessment Boundaries

- Tasks should not include the following:
  - Mathematical computation of equations and/or formulas of probability (qualitative probabilities can be used)
  - Recall of mathematical equations and formulas
  - Natural selection
  - Symbiotic relationships
  - Reproductive organs
  - Plant reproduction
  - Insect life cycles
  - Labeling a diagram/model
- All evidence for arguments must be provided.

### Possible Evidence

- When constructing an explanation, students will
  - use reasoning and argumentation to show
    - many characteristic animal behaviors affect the likelihood of successful reproduction.
    - many specialized plant structures affect the likelihood of successful reproduction.
    - that sometimes, animal behaviors play a role in the likelihood of successful reproduction in plants.
    - that because successful reproduction has several causes and contributing factors, the cause and effect relationships between any of these characteristics, separately or together, and reproductive likelihood can be accurately reflected only in terms of probability.
  - cause and effect relationships between
    - specialized plant structures and the probability of successful reproduction of plants that have those structures.
    - animal behaviors and the probability of successful reproduction of animals that exhibit those behaviors.
    - plant reproduction and the animal behaviors related to plant reproduction.



### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

### Sample Stems

#### **Characteristics of Corn Seeds**

##### Characteristics of Corn and Teosinte Seeds

<u>Corn Seeds</u>	<u>Teosinte Seeds</u>
	
<ul style="list-style-type: none"><li>• usually yellow in color</li><li>• seeds are exposed because they are not covered by a casing</li><li>• seeds remain on the plant's cob after they mature</li></ul>	<ul style="list-style-type: none"><li>• dark brown in color</li><li>• tough, hard seed casing surrounds each seed</li><li>• seeds easily release from the stalk of the plant after they mature</li></ul>

1. Teosinte is a form of wild corn and is grown in the same area where general corn is grown.

a. Which type of plant would likely be more successful at producing offspring that would develop into new plants?

b. Select the two reasons to support your answer to Part A.

Wildebeest are large animals living in Africa. When they travel, they travel in herds. Wildebeest will position their young in the center of the herd.

1. Explain how traveling in herds protects the wildebeest and their young.

Explanation for wildebeest:


Explanation for young:

Life Sciences		6-8.LS1.B.2
<b>Core Idea Component MLS</b>	<b>From Molecules to Organisms: Structure and Processes</b> <b>Growth and Development of Organisms</b> Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	
<b><u>Expectation Unwrapped</u></b> <p>[Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large-breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]</p> <p><b><u>SCIENCE AND ENGINEERING PRACTICES</u></b></p> <p><b>Constructing Explanations and Designing Solutions</b></p> <ul style="list-style-type: none"> <li>Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</li> </ul> <p><b><u>DISCIPLINARY CORE IDEAS</u></b></p> <p><b>Growth and Development of Organisms</b></p> <ul style="list-style-type: none"> <li>Genetic factors as well as local conditions affect the growth of the adult plant.</li> </ul> <p><b><u>CROSSCUTTING CONCEPTS</u></b></p> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described only by using probability.</li> </ul>		<b><u>DOK Ceiling</u></b> 3 <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced

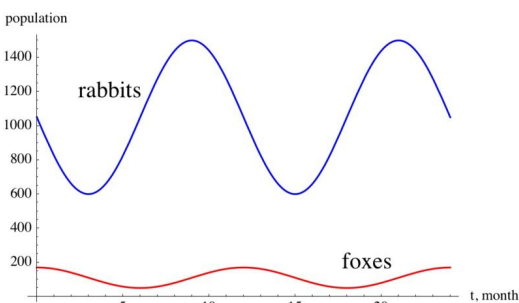


<p style="text-align: center;"><b><u>Content Limits/Assessment Boundaries</u></b></p> <ul style="list-style-type: none"> <li>● Tasks should not include the following: <ul style="list-style-type: none"> <li>○ The process of inheritance</li> <li>○ Biochemical processes (e.g., translation and transcription of DNA)</li> <li>○ Labeling a diagram/model</li> </ul> </li> <li>● All evidence for arguments must be provided.</li> </ul>	<p style="text-align: center;"><b><u>Sample Stems</u></b></p> <p>A hiker was walking along a trail in a state park. While she was walking, she noticed that the plants along the edge of the trail had very few blooms on them. It looked like many of them had been stepped on by other hikers. She also noticed a plant that had been pulled out of the ground. It had a very short root system.</p> <p>As she walked along, she noticed a large field. The plants that were there had many blooms on them. A small stream running through the field.</p> <ol style="list-style-type: none"> <li>1. Give 2 environmental factors that could be a piece of evidence that explains why the flowers in the field are healthier than the ones along the trail.</li> <li>2. Give 1 genetic factor that could be a piece of evidence that explains why the flowers in the field are healthier than the ones along the trail?</li> </ol>
<p style="text-align: center;"><b><u>Possible Evidence</u></b></p> <ul style="list-style-type: none"> <li>● Students use reasoning, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to connect the evidence and support an explanation for a phenomenon involving genetic and environmental influences on organism growth.</li> <li>● Students obtain, evaluate, and communicate information that relates the given phenomenon to a scientific idea, including the idea that both environmental and genetic factors influence the growth of organisms.</li> <li>● Students identify and describe evidence (e.g., from students' own investigations, from observations, from reading material, from archived data) about the following: <ul style="list-style-type: none"> <li>○ Environmental factors (e.g., availability of light, space, water, size of habitat) and that they can influence growth</li> <li>○ Genetic factors (e.g., specific breeds of plants and animals and their typical sizes) and that they can influence growth</li> <li>○ Changes in the growth of organisms as specific environmental and genetic factors change</li> </ul> </li> </ul>	
<p style="text-align: center;"><b><u>Stimulus Materials</u></b></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>	

Life Sciences		6-8.LS1.C.1
Core Idea Component MLS	<b>From Molecules to Organisms: Structure and Processes</b> <b>Organization for Matter and Energy Flow in Organisms</b> Construct a scientific explanation based on evidence for the role of photosynthesis and cellular respiration in the cycling of matter and flow of energy into and out of organisms.	
<b><u>Expectation Unwrapped</u></b> [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Constructing Explanations and Designing Solutions</b> <ul style="list-style-type: none"> <li>Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Organization for Matter and Energy Flow in Organisms</b> <ul style="list-style-type: none"> <li>Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.</li> </ul> <b>Energy in Chemical Processes and Everyday Life</b> <ul style="list-style-type: none"> <li>The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (e.g., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen.</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Energy and Matter</b> <ul style="list-style-type: none"> <li>Within a natural system, the transfer of energy drives the motion and/or the cycling of matter.</li> </ul>		<b><u>DOK Ceiling</u></b> 3 <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced

<p style="text-align: center;"><b><u>Content Limits/Assessment Boundaries</u></b></p> <ul style="list-style-type: none"> <li>● Tasks should not include the following: <ul style="list-style-type: none"> <li>○ Chemical mechanisms of photosynthesis/cellular respiration (e.g., light and dark cycles)</li> <li>○ Recall of photosynthesis equation/cellular respiration</li> <li>○ Labeling a diagram/model</li> </ul> </li> <li>● All evidence for arguments must be provided.</li> <li>● All chemical equations must be provided.</li> </ul>	<p style="text-align: center;"><b><u>Sample Stems</u></b></p> <p>A glass house can keep plants alive in a self-regulated internal climate. In 1960, David Latimer planted four seedlings in a jug and he hasn't watered it since 1972. However, the plants are still alive!</p>
<p style="text-align: center;"><b><u>Possible Evidence</u></b></p> <ul style="list-style-type: none"> <li>● Students construct an explanation; obtain, evaluate, and communicate information; and/or engage in an argument from evidence to show understanding of the fact that <ul style="list-style-type: none"> <li>○ photosynthesis results in the cycling of matter and energy into and out of organisms.</li> <li>○ all food and most of the oxygen animals use for life processes are the results of energy from the sun.</li> <li>○ the process of photosynthesis includes the conversion of carbon dioxide and water into complex carbon-based molecules (sugars) and oxygen; the contribution of sugars to plant growth and internal processes; as well as from plants to other organisms.</li> <li>○ plant, algae, and photosynthetic microorganisms require energy (in the form of sunlight) and must take in carbon dioxide and water to survive.</li> <li>○ energy from sunlight is used to combine simple nonfood molecules (i.e., carbon dioxide and water) into food molecules (i.e., sugar), which can be used immediately or stored by the plant for energy, growth, and other necessary functions (e.g., repair, seed production).</li> <li>○ animals take in food and oxygen to provide energy and materials for growth and survival.</li> <li>○ some animals eat plants, algae, and photosynthetic microorganisms, and some animals eat other animals</li> <li>○ oxygen that was breathed in was released when plants use energy to rearrange carbon dioxide and water during photosynthesis.</li> </ul> </li> </ul>	 <p style="text-align: center;"><b>Terrarium</b></p> <ol style="list-style-type: none"> <li>1. What evidence is there that energy is being conserved in this system?</li> <li>2. What evidence is there that matter is conserved in this cycle?</li> <li>3. How can the plants survive without being watered since 1972?</li> </ol>
<p style="text-align: center;"><b><u>Stimulus Materials</u></b></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>	

Life Sciences		6-8.LS2.A.1
Core Idea Component MLS	<b>Ecosystems: Interactions, Energy, and Dynamics</b> <b>Interdependent Relationships in Ecosystems</b> Analyze and interpret data to provide evidence for the effects of resource availability on individual organisms and populations of organisms in an ecosystem.	
<u><b>Expectation Unwrapped</b></u>  [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]  <u><b>SCIENCE AND ENGINEERING PRACTICES</b></u> <b>Analyzing and Interpreting Data</b> <ul style="list-style-type: none"> <li>Analyze and interpret data to provide evidence for phenomena.</li> </ul> <u><b>DISCIPLINARY CORE IDEAS</b></u> <b>Interdependent Relationships in Ecosystems</b> <ul style="list-style-type: none"> <li>Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.</li> <li>In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.</li> <li>Growth of organisms and population increases are limited by access to resources.</li> </ul> <u><b>CROSSCUTTING CONCEPTS</b></u> <b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</li> </ul>		<u><b>DOK Ceiling</b></u> 3  <u><b>Item Format</b></u> Selected Response Constructed Response Technology Enhanced

<p style="text-align: center;"><b><u>Content Limits/Assessment Boundaries</u></b></p> <ul style="list-style-type: none"> <li>● Tasks should not include the following: <ul style="list-style-type: none"> <li>○ Analysis of data beyond given data sets</li> <li>○ Recall of mathematical equations and formulas</li> <li>○ Labeling a diagram/model</li> <li>○ Mathematical computation of equations and/or formulas of probability (qualitative probabilities can be used)</li> </ul> </li> <li>● All evidence for arguments must be provided.</li> </ul>	<p style="text-align: center;"><b><u>Sample Stems</u></b></p> 
<p style="text-align: center;"><b><u>Possible Evidence</u></b></p> <ul style="list-style-type: none"> <li>● Students will analyze and interpret data based on the organization of data (e.g., tables, graphs, charts). <ul style="list-style-type: none"> <li>○ Examples could include populations (e.g., sizes, reproduction rates, growth information) or organisms as a function of resource availability.</li> <li>○ Examples could include the growth of individual organisms as a function of resource availability.</li> </ul> </li> <li>● Students will analyze the organized data to determine relationships.</li> <li>● Students will determine whether the relationships provide evidence of a causal link between factors. <ul style="list-style-type: none"> <li>○ Changes in the amount and availability of a given resource (e.g., less food) may result in changes in the population of an organism (e.g., less food results in fewer organisms) or growth of the individual organism (e.g., more food allows an organism to grow larger)</li> <li>○ Resource availability drives competition among organisms, both within a population as well as between populations, or has an effect on a population's rate of reproduction.</li> </ul> </li> </ul>	<ol style="list-style-type: none"> <li>1. Describe the cause for the patterns you observe in the graph.</li> <li>2. How do you know the population of rabbits and foxes are related?</li> <li>3. What if there was an extended drought? How would the graph be affected?</li> </ol>
<p style="text-align: center;"><b><u>Stimulus Materials</u></b></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>	

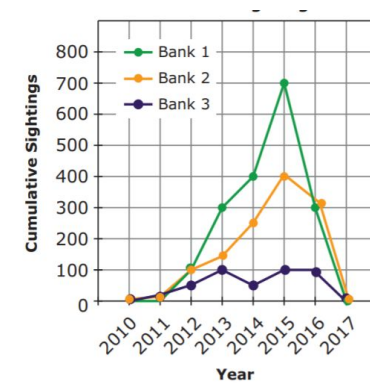
Life Sciences		6-8.LS2.A.2
Core Idea Component MLS	<b>Ecosystems: Interactions, Energy, and Dynamics</b> <b>Interdependent Relationships in Ecosystems</b> Construct an explanation that predicts the patterns of interactions among and between the biotic and abiotic factors in a given ecosystem.	
<b><u>Expectation Unwrapped</u></b>  [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Constructing Explanations and Designing Solutions</b> <ul style="list-style-type: none"> <li>Construct an explanation that includes qualitative and quantitative relationships between variables that predict phenomena.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Interdependent Relationships in Ecosystems</b> <ul style="list-style-type: none"> <li>Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in the competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environment, both living and nonliving, are shared.</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Patterns</b> <ul style="list-style-type: none"> <li>Patterns can be used to identify cause and effect relationships.</li> </ul>		<b><u>DOK Ceiling</u></b> 3  <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced

<p><b><u>Content Limits/Assessment Boundaries</u></b></p> <ul style="list-style-type: none"><li>● Tasks should not include the following:<ul style="list-style-type: none"><li>○ Student understanding of specific animal identification/behaviors</li><li>○ Analysis of data beyond given data sets</li><li>○ Labeling a diagram/model</li></ul></li><li>● All evidence for arguments must be provided.</li><li>● Assessment vocabulary should be limited to predation, competition, and symbiosis.</li></ul>	<p><b><u>Sample Stems</u></b></p> <p>Students hear about a spearfishing tournament where the top prize is awarded to the team who brings back the most lionfish. They wonder why the only fish being caught in this tournament are lionfish. They learn that lionfish are native to the Pacific and Indian Oceans and had not been seen in the Atlantic Ocean or the Gulf of Mexico at all until 1980. The lionfish population in the Atlantic Ocean has greatly increased since 2010. After researching more about lionfish, the students record the facts that they found. Figure 1 shows the number of lionfish sightings at three banks<sup>1</sup> (Bank 1, Bank 2, and Bank 3) along the Florida coast in the Gulf of Mexico.</p> <p><sup>1</sup>bank - an undersea elevation</p> <p>The students learned some facts about lionfish in the Atlantic Ocean from 2015 to 2016. See their notes in the table below.</p>		
<p><b><u>Possible Evidence</u></b></p> <ul style="list-style-type: none"><li>● Students will construct explanations that include qualitative or quantitative relationships between variables that predict cause and effect relationships in ecosystems.</li><li>● Students will engage in arguments given from multiple valid and reliable sources.</li><li>● Students will analyze and interpret data to predict interactions in an ecosystem</li><li>● Students will describe how mutualism, commensalism, and parasitism<ul style="list-style-type: none"><li>○ affects resource availability and can affect interactions between organisms (e.g., organisms in mutually beneficial interactions can become so dependent upon one another that they cannot survive alone).</li><li>○ interactions occur across multiple and different ecosystems.</li></ul></li></ul>			
<p><b><u>Stimulus Materials</u></b></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>			

Student Notes		
Biology	Distribution	Population Control
50,000 eggs laid every 3 days	can reach depths of 300 m	64 restaurants serving lionfish
1 year until maturity	population is 17 times more dense in the Atlantic Ocean than in the Pacific Ocean	28,770 lionfish captured during sanctioned spearfishing events

18 venomous spikes as an adult	no known natural predators	spearfishing divers can reach depths of 40 m
	prey on over 100 fish species	
	1,000 lionfish can eat 5 million prey fish in 1 year	

**Figure 1: Number of Lionfish Sightings**



- Why has the lionfish population dramatically increased in the Atlantic Ocean? Select **two** correct answers.
  - Lionfish have a rapid reproductive cycle.
  - Lionfish are favored by seafood restaurants.
  - Lionfish have spikes that are venomous, thus are hazardous to human divers.
  - Lionfish are an invasive species and therefore disrupt Atlantic Ocean ecosystems.



2. The conditions for lionfish are different in the Atlantic Ocean and Pacific Ocean. Because lionfish are native to the Pacific Ocean, they have not caused the disruption in the Pacific Ocean that they have caused in the Atlantic Ocean.

Write each answer in the correct box.

A. Predators recognize lionfish and eat them.

B. Prey do not recognize lionfish or avoid them.

C. Predators do not recognize lionfish as prey.

D. Lionfish population is controlled by humans.

E. Ecosystems are more likely to have high biodiversity.

F. Fishing harvests are likely high because of stable ecosystems.

G. Prey recognize lionfish and avoid them.

**Atlantic Ocean**

**Pacific Ocean**

3. What are **two** benefits for the lionfish living in the Atlantic Ocean and the Gulf of Mexico versus lionfish living in the Pacific Ocean?

Life Sciences		6-8.LS2.B.1
<b>Core Idea Component MLS</b>	<b>Ecosystems: Interactions, Energy, and Dynamics</b> <b>Cycles of matter and Energy Transfer in Ecosystems</b> Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	
<b><u>Expectation Unwrapped</u></b>		<b><u>DOK Ceiling</u></b>
[Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems and on defining the boundaries of the system.]  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Developing and Using Models</b> <ul style="list-style-type: none"> <li>Develop a model to describe phenomena.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Cycle of Matter and Energy Transfer in Ecosystems</b> <ul style="list-style-type: none"> <li>Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plants or animal matter back into the soil in terrestrial environments or into the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Energy and Matter</b> <ul style="list-style-type: none"> <li>The transfer of energy can be tracked as energy flows through a natural system.</li> </ul> <b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> <ul style="list-style-type: none"> <li>Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</li> </ul>		3  <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced

### Content Limits/Assessment Boundaries

- Tasks should not include the following:
  - The use of chemical reactions to describe the processes (e.g., how energy moves through an ecosystem, not the specific chemical mechanisms of photosynthesis, cellular respiration, and decomposition)
  - Labeling a diagram/model
- All evidence for arguments must be provided.

### Possible Evidence

- Students will develop and use a model to describe energy transfers within an ecosystem and matter cycling among producers, consumers, and decomposers and between organisms and nonliving parts of the ecosystem.
- Using the model, students will construct an explanation between components within the ecosystem, including the following:
  - Energy transfer into and out of the system occurs at every level.
  - Energy transfer and matter cycling occurs
    - among producers, consumers, and decomposers (e.g., decomposers break down consumers and producers via chemical reactions and use the energy released from rearranging those molecules for growth and development).
    - between organisms and the nonliving parts of the system (e.g., producers use matter from the nonliving parts of the ecosystem and energy from the sun to produce food from nonfood materials).

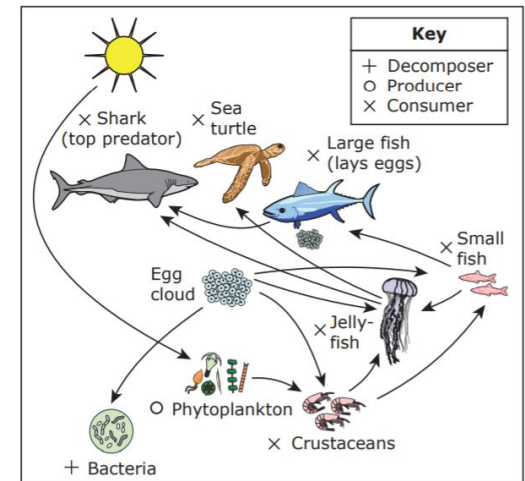
### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

### Sample Stems

Some students are visiting a coral reef off the coast of Florida. They notice a cloudy area in the water with a group of large fish in the middle. Many smaller fish are gathering there, too. After the cloudy area dissipates, the fish stop grouping up in the area. The students conduct further research and find that the cloudy area is called an “egg cloud.” The egg cloud is an area where fish have gathered to lay eggs to be fertilized. The students learn that the egg cloud provides energy for organisms that are both higher and lower than fish on the food chain. The students create Figure 1 to describe interactions in the reef ecosystem.

**Figure 1: Reef Ecosystem Interactions**



1. The students observe how energy and matter moves in the reef ecosystem. What are the primary sources of matter and energy in

	<p>the web? Select <b>two</b> correct answers.</p> <ol style="list-style-type: none"> <li>2. Describe how energy flows through the ecosystem from the sun to the egg cloud.</li> <li>3. Explain the role of bacteria in the cycling of matter in the ecosystem.</li> </ol>
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Life Sciences		6-8.LS2.C.1																																																						
Core Idea Component MLS	Ecosystems: Interactions, Energy, and Dynamics  Ecosystems Dynamics, Functioning, and Resilience  Construct an argument supported by empirical evidence that explains how changes to physical or biological components of an ecosystem affect populations.																																																							
	<div>Expectation Unwrapped</div> <div>[Clarification Statement: Emphasis is on recognizing patterns in data and making inferences about changes in populations, defining the boundaries of the system, and on evaluating empirical (quantitative) evidence supporting arguments about changes to ecosystems.]</div> <div>SCIENCE AND ENGINEERING PRACTICES</div> <div>Engaging in Argument from Evidence</div> <div><ul style="list-style-type: none"><li>Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomena or a solution to a problem.</li></ul></div> <div>Scientific Knowledge Is Based on Empirical Evidence</div> <div><ul style="list-style-type: none"><li>Science disciplines share common rules of obtaining and evaluating empirical evidence.</li></ul></div> <div>DISCIPLINARY CORE IDEAS</div> <div>Ecosystem Dynamics, Functioning, and Resilience</div> <div><ul style="list-style-type: none"><li>Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological components of an ecosystem can lead to shifts in all of its populations.</li></ul></div> <div>CROSSCUTTING CONCEPTS</div> <div>Stability and Change</div> <div><ul style="list-style-type: none"><li>Small changes in one part of a system might cause large changes in another part.</li></ul></div>		<div>DOK Ceiling</div> <div>3</div> <div>Item Format</div> <div>Selected Response</div> <div>Constructed Response</div> <div>Technology Enhanced</div>																																																					
<div>Content Limits/Assessment Boundaries</div> <div><ul style="list-style-type: none"><li>Tasks should not include the following:<ul style="list-style-type: none"><li>The types and steps of environmental succession</li><li>Analysis of data beyond given data sets</li><li>Labeling a diagram/model</li><li>Mathematical computation of equations and/or formulas of probability (qualitative probabilities can be used)</li></ul></li></ul></div>		<div>Sample Stems</div> <div><div>Data: Estimated monarch butterfly population size in millions of butterflies for each year</div><div>NOTE: This past winter's population of 57 million is 80% below the long-term average of 300 million.</div><table><tr><td>'95</td><td>'96</td><td>'97</td><td>'98</td><td>'99</td><td>'00</td><td>'01</td><td>'02</td><td>'03</td><td>'04</td><td>'05</td><td>'06</td><td>'07</td><td>'08</td><td>'09</td><td>'10</td><td>'11</td><td>'12</td><td>'13</td><td>'14</td></tr><tr><td>631</td><td>910</td><td>289</td><td>278</td><td>449</td><td>142</td><td>468</td><td>377</td><td>556</td><td>110</td><td>296</td><td>334</td><td>231</td><td>253</td><td>96</td><td>201</td><td>145</td><td>60</td><td>34</td><td>57</td></tr></table><div>Data: Area of Oyamel Forest not affected by logging within a 420 km² region over 45 years</div><table><tr><td>1971</td><td>1979</td><td>1984</td><td>1991</td><td>1999</td><td>2007</td><td>2014</td></tr><tr><td>274 km²</td><td>251 km²</td><td>220 km²</td><td>179 km²</td><td>153 km²</td><td>139 km²</td><td>123 km²</td></tr></table></div>	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	631	910	289	278	449	142	468	377	556	110	296	334	231	253	96	201	145	60	34	57	1971	1979	1984	1991	1999	2007	2014	274 km²	251 km²	220 km²	179 km²	153 km²	139 km²	123 km²
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<ul style="list-style-type: none"> <li>● All evidence for arguments must be provided.</li> </ul>	
<p style="text-align: center;"><b><u>Possible Evidence</u></b></p> <ul style="list-style-type: none"> <li>● Students obtain, evaluate, and communicate information to describe evidence (e.g., data from scientific literature) regarding             <ul style="list-style-type: none"> <li>○ changes in the physical or biological components of an ecosystem (e.g., rainfall, fires, predator removal, species introduction) including the magnitude of the changes.</li> <li>○ changes in the populations of an ecosystem (e.g., population size, types of species present, relative prevalence of a species within the ecosystem) including the magnitude of the changes.</li> </ul> </li> <li>● Students engage in an argument from evidence regarding causal relationships between physical and biological components of an ecosystem and changes in organism populations, based on patterns in the evidence.</li> <li>● Reasoning in arguments could include the following:             <ul style="list-style-type: none"> <li>○ Specific changes in the physical or biological components of an ecosystem cause changes that can affect the survival and reproductive likelihood of organisms within the ecosystem (e.g., scarcity of food will alter the survival and reproductive probability of some organisms).</li> <li>○ Factors that affect the survival and reproduction of organisms can cause changes in the populations of those organisms.</li> <li>○ Patterns in the evidence suggest that many different types of changes (i.e., changes in multiple types of physical and biological components) are correlated with changes in organism populations.</li> <li>○ Several consistent correlational patterns, along with the understanding of specific causal relationships between changes in the components of an ecosystem and changes in the survival and reproduction of organisms, suggest that many changes in physical or biological components of ecosystems can cause changes in populations of organisms.</li> <li>○ Some small changes in physical or biological components of an ecosystem are associated with large changes in a population, suggesting that small changes in one component of an ecosystem can cause large changes in another component.</li> </ul> </li> </ul>	<ol style="list-style-type: none"> <li>1. What things change in the system?</li> <li>2. Is the system described in the scenario stable or unstable? Present evidence to support your claim.</li> <li>3. Develop a claim and support it with evidence regarding how the area of unlogged forest land has affected the butterfly population.</li> </ol>
<p style="text-align: center;"><b><u>Stimulus Materials</u></b></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>	

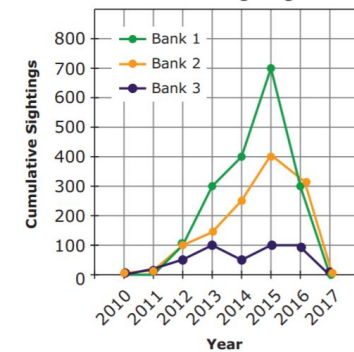
Life Sciences		6-8.LS2.C.2
<b>Core Idea Component MLS</b>	<b>Ecosystems: Interactions, Energy, and Dynamics</b> <b>Ecosystems Dynamics, Functioning, and Resilience</b> Evaluate benefits and limitations of differing design solutions for maintaining an ecosystem.	
<b><u>Expectation Unwrapped</u></b>  [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Engaging in an Argument from Evidence</b> <ul style="list-style-type: none"> <li>Evaluate competing design solutions based on jointly developed and agreed upon design criteria</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Ecosystem Dynamics, Functioning, and Resilience</b> <ul style="list-style-type: none"> <li>Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem biodiversity is often used as a measure of its health.</li> </ul> <b>Biodiversity and Humans</b> <ul style="list-style-type: none"> <li>Changes in biodiversity can influence humans’ resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on (e.g., water purification and recycling).</li> </ul> <b>Developing Possible Solutions</b> <ul style="list-style-type: none"> <li>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.</li> <li>See ETS1.A.1 for connection</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Stability and Change</b> <ul style="list-style-type: none"> <li>Small changes in one part of a system might cause large changes in another part.</li> </ul> <b>Influence of Science, Engineering, and Technology on Society in the Natural World</b> <ul style="list-style-type: none"> <li>The use of technologies and any limitations on their use are driven by individual societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural</li> </ul>		<b><u>DOK Ceiling</u></b> 3
		<b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced

resources and economic conditions. Thus, technology use varies from region to region over time.										
<p><b>Science Address Questions about the Natural and Material World</b></p> <ul style="list-style-type: none"><li>Scientific knowledge can describe the consequences and actions but does not necessarily prescribe the decisions that society takes.</li></ul>										
<p><b><u>Content Limits/Assessment Boundaries</u></b></p> <ul style="list-style-type: none"><li>Tasks should not include the following:<ul style="list-style-type: none"><li>Steps of design cycles (e.g., scientific method)</li><li>Recall of mathematical equations and formulas</li><li>Labeling a diagram/model</li></ul></li><li>All evidence for arguments must be provided.</li><li>Analysis of benefits and limitations of any design solution should be limited to given data sets</li></ul>	<p><b><u>Sample Stems</u></b></p> <p>Students hear about a spearfishing tournament where the top prize is awarded to the team who brings back the most lionfish. They wonder why the only fish being caught in this tournament are lionfish. They learn that lionfish are native to the Pacific and Indian Oceans and had not been seen in the Atlantic Ocean or the Gulf of Mexico at all until 1980. The lionfish population in the Atlantic Ocean has greatly increased since 2010. After researching more about lionfish, the students record the facts that they found. Figure 1 shows the number of lionfish sightings at three banks<sup>1</sup> (Bank 1, Bank 2, and Bank 3) along the Florida coast in the Gulf of Mexico.</p> <p><sup>1</sup>bank - an undersea elevation</p> <p>The students learned some facts about lionfish in the Atlantic Ocean from 2015 to 2016. See their notes in the table below.</p>									
<p><b><u>Possible Evidence</u></b></p> <ul style="list-style-type: none"><li>Students will construct explanations and design solutions for maintaining the biodiversity of an ecosystem.</li><li>Students will engage in arguments from evidence relevant to a problem or design solution. The evaluation of the solutions should include the following:<ul style="list-style-type: none"><li>The variety of species found in the given ecosystem</li><li>The factors that affect biodiversity stability in the given ecosystem</li><li>The services that affect the stability of the given ecosystem</li></ul></li><li>Students will<ul style="list-style-type: none"><li>compare the ability of each of the competing design solutions to maintain ecosystem stability and biodiversity.</li><li>clarify the strengths and weaknesses of the competing designs based on scientific, social, and economic considerations.</li><li>assess possible side effects of the given design solutions on other aspects of the ecosystem (e.g., a small change in one component of an ecosystem producing a large change in another component of the ecosystem).</li></ul></li></ul>	<table><tr><th colspan="3">Student Notes</th></tr><tr><th>Biology</th><th>Distribution</th><th>Population Control</th></tr><tr><td>50,000 eggs laid every 3</td><td>can reach depths of</td><td>64 restaurants</td></tr></table>	Student Notes			Biology	Distribution	Population Control	50,000 eggs laid every 3	can reach depths of	64 restaurants
Student Notes										
Biology	Distribution	Population Control								
50,000 eggs laid every 3	can reach depths of	64 restaurants								
<p><b><u>Stimulus Materials</u></b></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings <i>fossil</i></p>										



	days	300 m	serving lionfish
	1 year until maturity	population is 17 times more dense in the Atlantic Ocean than in the Pacific Ocean	28,770 lionfish captured during sanctioned spearfishing events
	18 venomous spikes as an adult	no known natural predators	spearfishing divers can reach depths of 40 m
		prey on over 100 fish species	
		1,000 lionfish can eat 5 million prey fish in 1 year	

**Figure 1: Number of Lionfish Sightings**



1. Examine Figure 1. Provide **two** possible reasons the lionfish population in the Bank 1 region did not experience the same rapid growth that the other two regions experienced.
2. Based on the information provided, why are lionfish in the Atlantic Ocean a problem that needs to be controlled?
3. Complete the sentences to describe the impact of lionfish on Atlantic Ocean ecosystems. Write the correct answer in each box. Each answer may be used more than once.

☐ A. invasive   
 ☐ B. native   
 ☐ C. biodiversity   
 ☐ D. producers  
☐ E. decomposers

The lionfish is a(n)  predator in the Atlantic Ocean. Because of its consumption of over 100 prey fish species lionfish disrupt ecosystems by reducing the amount of . This reduction of prey fish can lead to a lack of food for  predators. To help return  to these ecosystems, humans have begun lionfish population control measures.

Life Sciences		6-8.LS4.A.1
Core Idea Component MLS	<b>Biological Evolution: Unity and Diversity</b> <b>Evidence of Common Ancestry and Diversity</b> Analyze and interpret evidence from the fossil record to infer patterns of environmental change resulting in extinction and changes to life forms throughout the history of the Earth.	
<p align="center"><b><u>Expectation Unwrapped</u></b></p> <p>[Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.]</p> <p><b><u>SCIENCE AND ENGINEERING PRACTICES</u></b></p> <p><b>Analyzing and Interpreting Data</b></p> <ul style="list-style-type: none"> <li>Analyze and interpret data to determine similarities and differences in findings.</li> </ul> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Science knowledge is based upon logical and conceptual connections between evidence and explanations.</li> </ul> <p><b><u>DISCIPLINARY CORE IDEAS</u></b></p> <p><b>Evidence of Common Ancestry and Diversity</b></p> <ul style="list-style-type: none"> <li>The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.</li> </ul> <p><b><u>CROSSCUTTING CONCEPTS</u></b></p> <p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Graphs, charts, and images can be used to identify patterns in data.</li> </ul> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b></p> <ul style="list-style-type: none"> <li>Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</li> </ul>		<p align="center"><b><u>DOK Ceiling</u></b></p> <p align="center">3</p> <p align="center"><b><u>Item Format</u></b></p> <p>Selected Response Constructed Response Technology Enhanced</p>

### Content Limits/Assessment Boundaries

- Tasks should not include the following:
  - Recall of geological eras in the fossil record
  - Recall of the names and identification of fossils
  - Dates of major events (e.g., ice ages, asteroid impacts, volcanic eruptions, organism extinctions/evolutions)
  - Labeling a diagram/model
  - Analysis of data beyond given data sets
  - Mathematical computation of equations and/or formulas
- All evidence for arguments must be provided.

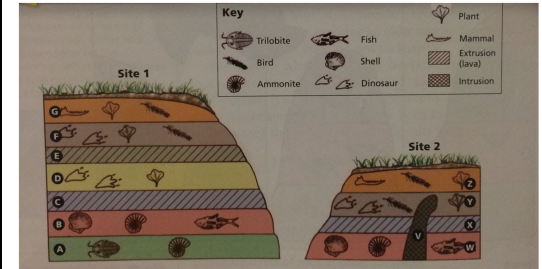
### Possible Evidence

- Students will analyze and interpret data (e.g., tables, graphs, charts, images), including the following:
  - The appearance of specific types of fossilized organisms in the fossil record as a function of time, as determined by their locations in the sedimentary layers or the ages of rocks
  - Patterns between sedimentary layers and the relative ages of those layers
  - Time period(s) during which a given fossil organism is present in the fossil record
  - Periods of time for which changes in the presence or absence of large numbers of organisms or specific types of organisms can be observed in the fossil record (e.g., a fossil layer with very few organisms immediately next to a fossil layer with many types of organisms)
  - Patterns of changes in the level of complexity of anatomical structures in organisms in the fossil record, as a function of time

### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

### Sample Stems

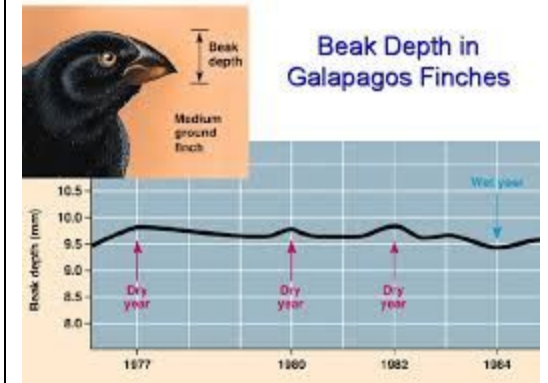


1. a. Which layers from site one and site two occurred at the same time?  
b. How do you know? Describe evidence for your answer to Part A.
2. For site 1, what is the timeline of events?
3. For site 2, what is the timeline of events?

Life Sciences		6-8.LS4.B.1
<b>Core Idea Component MLS</b>	<b>Biological Evolution; Unity and Diversity</b> <b>Natural Selection</b> Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.	
<u><b>Expectation Unwrapped</b></u>  [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]  <u><b>SCIENCE AND ENGINEERING PRACTICES</b></u> <b>Constructing Explanations and Designing Solutions</b> <ul style="list-style-type: none"> <li>Construct an explanation that includes qualitative and quantitative relationships between variables that describe phenomena.</li> </ul> <u><b>DISCIPLINARY CORE IDEAS</b></u> <b>Natural Selection</b> <ul style="list-style-type: none"> <li>Natural selection leads to the predominance of certain traits in a population and the suppression of others.</li> </ul> <u><b>CROSCUTTING CONCEPTS</b></u> <b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</li> </ul>		<u><b>DOK Ceiling</b></u> 3  <u><b>Item Format</b></u> Selected Response Constructed Response Technology Enhanced
<u><b>Content Limits/Assessment Boundaries</b></u> <ul style="list-style-type: none"> <li>Tasks should not include the following: <ul style="list-style-type: none"> <li>Mathematical computation of equations, formulas of probability, and/or proportional reasoning</li> <li>Recall of mathematical equations and formulas</li> <li>Labeling a diagram/model</li> </ul> </li> <li>All evidence for arguments must be provided.</li> </ul>		<u><b>Sample Stems</b></u>

### Possible Evidence

- Students will plan and carry out investigations and construct explanations and design solutions in order to obtain, evaluate, and communicate information related to the following:
  - Any population in a given environment contains a variety of available, inheritable genetic traits (i.e. specific variations of a characteristic)
  - For a specific environment (i.e., different environments may have limited food availability, predators, nesting site availability, light availability), some traits confer advantages that make it more probable that an organism will be able to survive and reproduce
  - In a population, there is a cause and effect relationship between the variation of traits and the probability that specific organisms will be able to survive and reproduce
  - Variation of traits is a result of genetic variations occurring in the population
  - The proportion of individual organisms that have genetic variations and traits that are advantageous in a particular environment will increase from generation to generation due to natural selection because the probability that those individuals will survive and reproduce is greater
  - Similarly, the proportion of individual organisms that have genetic variations and traits that are disadvantageous in a particular environment will be less likely to survive, and the disadvantageous traits will decrease from generation to generation due to natural selection



### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

During drought years the amount of small, soft seeds that finches feed upon decrease leaving only larger, tougher seeds. Rainy years yield smaller seed sizes. These seeds are the main food source for the finches.

1. The finches are found on the Galapagos. Looking at the two graphs, what would you say the amount of precipitation has been at the Galapagos?
2. How do you know the smaller seeds cause smaller beaks in finches?

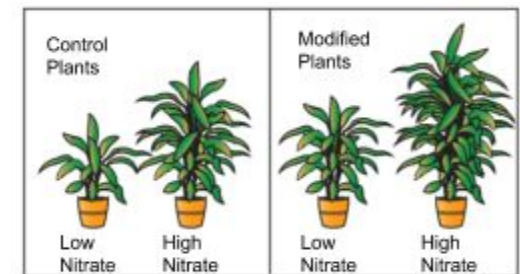
Life Sciences		6-8.LS4.B.2
Core Idea Component MLS	<b>Biological Evolution; Unity and Diversity</b>  <b>Natural Selection</b> Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.	
<b><u>Expectation Unwrapped</u></b>  [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Obtaining, Evaluating, and Communicating Information</b> <ul style="list-style-type: none"> <li>Gather, read, and synthesize information from multiple appropriate sources and assess the credibility accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Natural Selection</b> <ul style="list-style-type: none"> <li>In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Cause and Effect</b> <ul style="list-style-type: none"> <li>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</li> </ul> <b>Interdependence of Science, Engineering, and Technology</b> <ul style="list-style-type: none"> <li>Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.</li> </ul> <b>Science Addresses Questions About the Natural and Material World</b> <ul style="list-style-type: none"> <li>Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.</li> </ul>		<b><u>DOK Ceiling</u></b> 3  <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced

<p><b><u>Content Limits/Assessment Boundaries</u></b></p> <ul style="list-style-type: none"><li>● Tasks should not include the following:<ul style="list-style-type: none"><li>○ Recall of specific technologies</li><li>○ Labeling a diagram/model</li></ul></li><li>● All evidence for arguments must be provided.</li></ul>	<p><b><u>Sample Stems</u></b></p> <p>On a field trip to a lumber mill in Oregon, students learn that poplar trees are used for their wood. The tour guide tells the students that wood production is down this year because many poplar trees are being infected by a fungal disease called leaf spot and because the region has experienced a drought, with much less rain than usual over the last several years. The guide explains that scientists are trying two different solutions to the problem of decreased wood production. The first solution is to take cuttings from groups of poplar trees that have desirable traits and replant them as seedlings to grow as new trees. The results of one of these experiments is shown in Table 1. In this experiment, a lumber company planted equal numbers of seedlings from three groups of poplars, just east of the Cascade Mountains of Oregon, and then years later, scientists returned to count the number of seedlings of that group that remained and grew into young trees.</p> <p><b>Table 1: Survival of Poplar Seedlings</b></p> <table><tr><th>Poplar Tree Group</th><th>Number of Surviving Seedlings</th></tr><tr><td>A</td><td>6810</td></tr><tr><td>B</td><td>3233</td></tr><tr><td>C</td><td>1918</td></tr></table> <p>The second solution is to develop genetically modified poplars that can better utilize nitrate fertilizer in the soil. An experiment examined the height (in</p>	Poplar Tree Group	Number of Surviving Seedlings	A	6810	B	3233	C	1918
Poplar Tree Group	Number of Surviving Seedlings								
A	6810								
B	3233								
C	1918								
<p><b><u>Possible Evidence</u></b></p> <ul style="list-style-type: none"><li>● Students obtain, evaluate, and communicate information about two technologies that have changed the way humans influence the inheritance of desired traits in plants and animals through artificial selection by choosing desired parental traits, which are then often passed onto offspring.</li><li>● Students engage in an argument from evidence to<ul style="list-style-type: none"><li>○ assess the credibility, accuracy, and possible bias of each publication and method used in the information gathered.</li><li>○ Biased publications could include those by people who make a living through selective breeding (e.g., some farmers) and how those individuals could be biased toward selective breeding.</li><li>○ use knowledge and additional sources to describe how the information gathered is or is not supported by evidence.</li></ul></li></ul>									
<p><b><u>Stimulus Materials</u></b></p> <p>Graphic organizers, diagrams, graphs, data tables, drawings</p>									



centimeters) and biomass (in grams) of the new genetically modified seedlings by comparing the groups of modified seedlings to groups of unmodified seedlings after 3 months of growth. Each group of trees had been treated with either a low or high concentration of nitrate solution to serve as fertilizer. The results of this experiment are shown in Figure 1 and Table 2. Figure 1 shows representatives of the average seedling of each group listed in Table 2.

**Figure 1: Representatives of Average Poplar Seedlings**



**Table 2: Poplar Tree Height and Biomass after 3 months**

Popular Tree Group	Average Height (cm)	Average Biomass (g)
C-Low	32	14
C-High	52	19
M-Low	39	15
M-High	64	33

1. What caused the patterns you observed Table 1?
2. Which poplar tree group seems to be most successful? What characteristics do you assume the group of trees to have?
3. What caused the patterns you observed in Table 2? Figure 1?

	<p><b>4. Which poplar tree group seems to be most successful?</b></p> <p><b>5. What do you think is the best solution?</b></p>
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Life Sciences		6-8.LS4.C.1
Core Idea Component MLS	<b>Biological Evolution; Unity and Diversity</b>  <b>Adaptation</b> Interpret graphical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	
<p align="center"><b><u>Expectation Unwrapped</u></b></p> <p>[Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.]</p> <p><b><u>SCIENCE AND ENGINEERING PRACTICES</u></b></p> <p><b>Using Mathematics and Computational Thinking</b></p> <ul style="list-style-type: none"> <li>Use mathematical representations to support scientific conclusions and design solutions.</li> </ul> <p><b><u>DISCIPLINARY CORE IDEAS</u></b></p> <p><b>Adaptation</b></p> <ul style="list-style-type: none"> <li>Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.</li> </ul> <p><b><u>CROSSCUTTING CONCEPTS</u></b></p> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</li> </ul>		<p align="center"><b><u>DOK Ceiling</u></b></p> <p align="center">3</p>
		<p align="center"><b><u>Item Format</u></b></p> <p>Selected Response Constructed Response Technology Enhanced</p>
<p align="center"><b><u>Content Limits/Assessment Boundaries</u></b></p> <ul style="list-style-type: none"> <li>Tasks should provide students with all needed equations, formulas, and data sets.</li> </ul>		<p align="center"><b><u>Sample Stems</u></b></p> <p>A survey of African savanna elephants revealed that populations declined by 30% between 2007 and 2014. As of 2014, about 350,000 savanna elephants were living in Africa. Their current rate of decline is 8% per year, primarily due to illegal killing, called poaching.</p>

### Possible Evidence

- Using math and computational thinking, students identify relevant components, including the following:
  - Population changes (e.g., trends, averages, histograms, graphs, spreadsheets) gathered from historical data or simulations
  - The distribution of specific traits over time from data and/or simulations
  - Environmental conditions (e.g., climate, resource availability) over time from data and/or simulations
  - Changes and trends over time in the distribution of traits within a population
  - Multiple cause and effect relationships between environmental conditions and natural selection in a population
  - The increases or decreases of some traits within a population can have more than one environmental cause
- Students analyze and interpret data as evidence to support the following explanations:
  - Through natural selection, traits that better support survival and reproduction are more common in a population than those traits that are less effective.
  - Populations are not always able to adapt and survive because adaptation by natural selection occurs over generations.
  - Because there are multiple cause and effect relationships contributing to the phenomenon, for each different cause, it is not possible to predict with 100% certainty what will happen.

### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

**Data Table 1:**

*Elephants killed illegally in North Luangwa Valley, eastern Zambia, 2007–2013 (Njirinda et al., 2015).*

Elephant Type	Number Illegally Killed Each Year							Total
	2007	2008	2009	2010	2011	2012	2013	
Tusks Naturally Present	4	6	11	12	17	33	42	125
Tusks Naturally Absent (Tuskless)	0	0	1	0	2	0	1	4
<b>Total Number Illegally Killed</b>	<b>4</b>	<b>6</b>	<b>12</b>	<b>12</b>	<b>19</b>	<b>33</b>	<b>43</b>	<b>129</b>

**Data Table and Graph 2:**

Level of Human Activity	Adult Females		Adult Males	
	Total Number	Percent Tuskless	Total Number	Percent Tuskless
Environment with Minimal Human Activity	365	1.1%	93	0.0%
Environment with High Levels of Poaching	352	12.8%	31	0.0%

1. Using the data, create a graphical representation of the survival rate of Savannah Elephants with tusks versus no tusks.
2. Is the change in the tuskless population due to natural selection? Provide evidence to support your claim.
3. If poaching is prevented, what is the impact on the elephant population?

Engineering, Technology, and Application of Science		6-8.ETS1.A.1
<b>Core Idea Component MLS</b>	<b>Engineering Design</b> <b>Defining and Delimiting Engineering Problems</b> Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	
<b><u>Expectation Unwrapped</u></b>		<b><u>DOK Ceiling</u></b> 3
<b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Asking Questions and Defining Problems</b> <ul style="list-style-type: none"> <li>Define a design problem that can be solved through the development of an object, tool, process, or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Defining and Delimiting Engineering Problems</b> <ul style="list-style-type: none"> <li>The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.</li> </ul> <b><u>CROSSCUTTING CONCEPTS</u></b> <b>Influence of Science, Engineering, and Technology on Society and the Natural World</b> <ul style="list-style-type: none"> <li>All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.</li> <li>The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.</li> </ul>		<b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced
<b><u>Content Limits/Assessment Boundaries</u></b> <ul style="list-style-type: none"> <li>Tasks should not require students to identify the exact solution to a given design problem.</li> </ul>		<b><u>Sample Stems</u></b> Some students read a quote by Charles Darwin. It says, "The number of living creatures of all orders whose existence intimately depends on kelp is wonderful." They research kelp forests and find out

### Possible Evidence

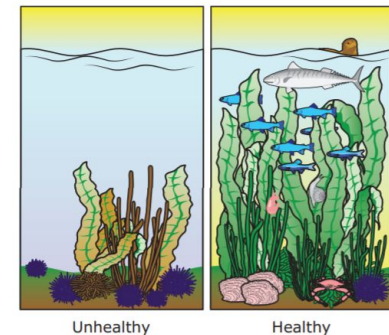
- Students describe a problem that can be solved through the development of an object, tool, process, or system.
- Students identify the system in which the problem is embedded, including the major components and relationships in the system and its boundaries, to clarify what is and is not part of the problem. In their definition of the system, students include the following:
  - Which individuals or groups need this problem to be solved
  - The needs that must be met by solving the problem
  - Scientific issues that are relevant to the problem
  - Potential societal and environmental impacts of solutions
  - The relative importance of the various issues and components of the process or system
- Students define criteria that must be taken into account in the solution and that
  - meet the needs of the individuals or groups who may be affected by the problem (including defining who will be the target of the solution).
  - enable comparisons among different solutions, including quantitative considerations when appropriate.
- Students define constraints that must be taken into account in the solution, including the following:
  - Time, materials, and costs
  - Scientific or other issues that are relevant to the problem
  - Needs and desires of the individuals or groups involved that may limit acceptable solutions
  - Safety considerations
  - Potential effects on other individuals or groups
  - Potential negative environmental effects of possible solutions or failure to solve the problem

### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

that biodiversity in these ecosystems is declining. The students find a picture comparing an unhealthy and healthy kelp forest (Figure 1). They examine the kelp forest food web (Figure 2). They also find some data about the effectiveness of two possible solutions to the decline of kelp forests (Figures 3 and 4).

**Figure 1: Unhealthy and Healthy Kelp Forests**



**Figure 2: Kelp Forest Food Web**

Figure 3 shows data collected after new kelp forests were planted off the coast of Costa Rica.

**Figure 3: Number of Species of Fish After Planting Kelp**

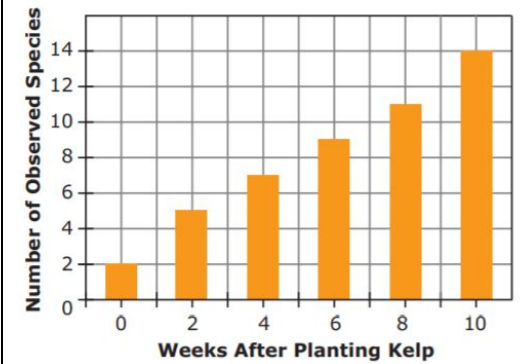


Figure 4 shows data collected after sea otters were reintroduced to existing kelp forests off the coast of Alaska. Biomass is the total mass of organisms in the ecosystem.

**Figure 4: Sea Urchin and Kelp Biomass**

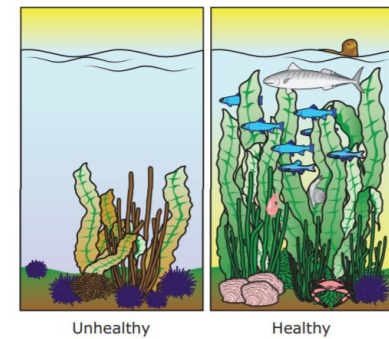
1. With the given problem above, what are the constraints of the problem and criteria for success?





Engineering, Technology, and Application of Science		6-8.ETS1.B.1
Core Idea Component MLS	<b>Engineering Design</b> <b>Developing Possible Solutions</b> Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	
<b><u>Expectation Unwrapped</u></b>  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Engaging in Argument from Evidence</b> <ul style="list-style-type: none"> <li>Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Developing Possible Solutions</b> <ul style="list-style-type: none"> <li>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.</li> </ul>		<b><u>DOK Ceiling</u></b> 3  <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced
<b><u>Content Limits/Assessment Boundaries</u></b> <ul style="list-style-type: none"> <li>Any analysis of data should be limited to given data sets.</li> <li>Tasks should provide students with all needed equations, formulas, and data sets.</li> </ul>		<b><u>Sample Stems</u></b>  Some students read a quote by Charles Darwin. It says, “The number of living creatures of all orders whose existence intimately depends on kelp is wonderful.” They research kelp forests and find out that biodiversity in these ecosystems is declining. The students find a picture comparing an unhealthy and healthy kelp forest (Figure 1). They examine the kelp forest food web (Figure 2). They also find some data about the effectiveness of two possible solutions to the decline of kelp forests (Figures 3 and 4).

**Figure 1: Unhealthy and Healthy Kelp Forests**



**Figure 2: Kelp Forest Food Web**

Figure 3 shows data collected after new kelp forests were planted off the coast of Costa Rica.

**Figure 3: Number of Species of Fish After Planting Kelp**

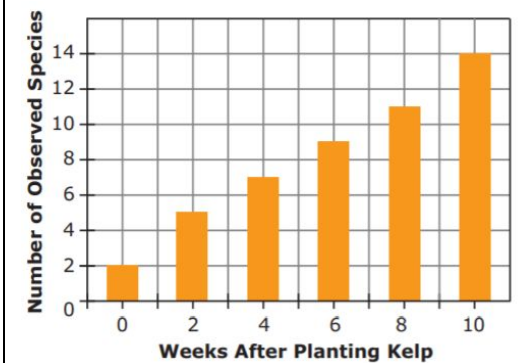


Figure 4 shows data collected after sea otters were reintroduced to existing kelp forests off the coast of Alaska. Biomass is the total mass of organisms in the ecosystem.

**Figure 4: Sea Urchin and Kelp Biomass**

1. Listed below are possible solutions, using the criteria and constraints defined with the first question to determine which of the following solutions is the best option?

A. Farm sea bass to be returned to the oceans

B. Hold contests to see how many sea urchins can be captured by divers

C. Design and build sea otter nurseries near kelp forests

D. Hire fish and wildlife officers to enforce sea bass capture limits

E. Gather signatures for a petition to pass laws that encourage kelp farming

**Solution Meets Criteria**

**Possible Evidence**

- Students identify the given supported design solution.
- Students identify scientific knowledge related to the problem and each proposed solution.
- Students identify how each solution would solve the problem.
- Students identify and describe additional evidence necessary for their evaluation, including the following:
  - Knowledge of how similar problems have been solved in the past.
  - Evidence of possible societal and environmental impacts of each proposed solution.
- Students collaboratively define and describe criteria and constraints for the evaluation of the design solution
- Students use a systematic method (e.g., a decision matrix) to identify the strengths and weaknesses of each solution. In their evaluation, students
  - evaluate each solution against each criterion and constraint.
  - compare solutions based on the results of their performance against the defined criteria and constraints.
- Students use the evidence and reasoning to make a claim about the relative effectiveness of each proposed solution based on the strengths and weaknesses of each.

**Stimulus Materials**

Graphic organizers, diagrams, graphs, data tables, drawings

Engineering, Technology, and Application of Science		6-8.ETS1.B.2
<b>Core Idea Component MLS</b>	<b>Engineering Design</b> <b>Developing Possible Solutions</b> Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	
<b><u>Expectation Unwrapped</u></b>  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Analyzing and Interpreting Data</b> <ul style="list-style-type: none"> <li>Analyze and interpret data to determine similarities and differences in findings.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Developing Possible Solutions</b> <ul style="list-style-type: none"> <li>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.</li> <li>Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.</li> </ul> <b>Optimizing the Design Solution</b> <ul style="list-style-type: none"> <li>Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.</li> </ul>		<b><u>DOK Ceiling</u></b> 3  <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced
<b><u>Content Limits/Assessment Boundaries</u></b> <ul style="list-style-type: none"> <li>Any analysis of data should be limited to given data sets</li> <li>Tasks should provide students with all needed equations, formulas, and data sets.</li> </ul>		<b><u>Sample Stems</u></b>  Some students read a quote by Charles Darwin. It says, “The number of living creatures of all orders whose existence intimately depends on kelp is wonderful.” They research kelp forests and find out that biodiversity in these ecosystems is declining. The students find a picture comparing an unhealthy and healthy kelp forest (Figure 1). They examine the kelp forest food web (Figure 2). They also find some data about the effectiveness of two
<b><u>Possible Evidence</u></b> <ul style="list-style-type: none"> <li>Students organize given data (e.g., tables, charts, graphs) from tests intended to determine the effectiveness of three or more alternative solutions to a problem.</li> </ul>		

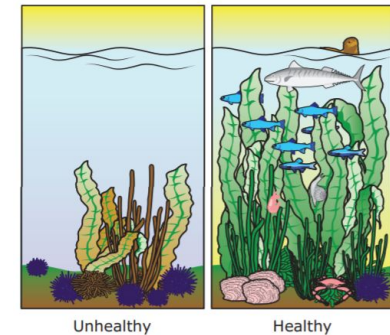
- Students use appropriate analysis techniques (e.g., qualitative or quantitative analysis, basic statistical techniques of data and error analysis) to analyze the data and identify relationships within the data sets, including relationships between the design solutions and the given criteria and constraints.
- Students use the analyzed data to identify evidence of similarities and differences in features of the solutions.
- Based on the analyzed data, students make a claim for which characteristics of each design best meet the given criteria and constraints.
- Students use the analyzed data to identify the best features in each design that can be compiled into a new (improved) redesigned solution.

### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

possible solutions to the decline of kelp forests (Figures 3 and 4).

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**Figure 2: Kelp Forest Food Web**

Figure 3 shows data collected after new kelp forests were planted off the coast of Costa Rica.

**Figure 3: Number of Species of Fish After Planting Kelp**

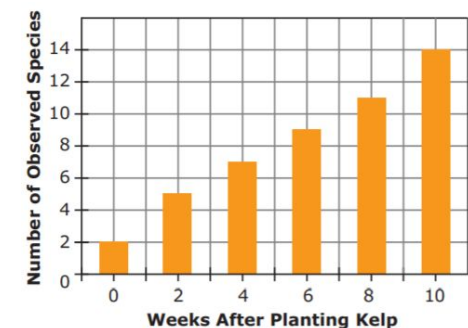


Figure 4 shows data collected after sea otters were reintroduced to existing kelp forests off the coast of Alaska. Biomass is the total mass of organisms in the ecosystem.

**Figure 4: Sea Urchin and Kelp Biomass**

1. The students want to find a solution that could restore biodiversity and stability of kelp forests but cost very little or no money. Determine if each solution meets these criteria. Write the two answers that best meet these criteria in the box. Not all answers will be used.

	A. Farm sea bass to be returned to the oceans	B. Hold contests to see how many sea urchins can be captured by divers
	C. Design and build sea otter nurseries near kelp forests	D. Hire fish and wildlife officers to enforce sea bass capture limits
	E. Gather signatures for a petition to pass laws that encourage kelp farming	
	<b>Solution Meets Criteria</b>	



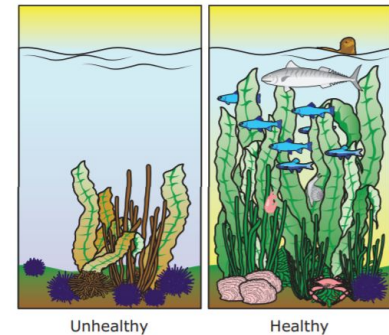
Engineering, Technology, and Application of Science		6-8.ETS1.B.3
<b>Core Idea Component MLS</b>	<b>Engineering Design</b> <b>Developing Possible Solutions</b> Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	
<b><u>Expectation Unwrapped</u></b>  <b><u>SCIENCE AND ENGINEERING PRACTICES</u></b> <b>Developing and Using Models</b> <ul style="list-style-type: none"> <li>Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.</li> </ul> <b><u>DISCIPLINARY CORE IDEAS</u></b> <b>Developing Possible Solutions</b> <ul style="list-style-type: none"> <li>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.</li> <li>Models of all kinds are important for testing solutions.</li> </ul> <b>Optimizing the Design Solution</b> <ul style="list-style-type: none"> <li>The iterative process of testing the most promising solutions and modifying that is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.</li> </ul>		<b><u>DOK Ceiling</u></b> 3  <b><u>Item Format</u></b> Selected Response Constructed Response Technology Enhanced
<b><u>Content Limits/Assessment Boundaries</u></b> <ul style="list-style-type: none"> <li>Any analysis of data should be limited to given data sets.</li> <li>Tasks should provide students with all needed equations, formulas, and data sets.</li> </ul>		<b><u>Sample Stems</u></b>  Some students read a quote by Charles Darwin. It says, “The number of living creatures of all orders whose existence intimately depends on kelp is wonderful.” They research kelp forests and find out that biodiversity in these ecosystems is declining. The students find a picture comparing an unhealthy and healthy kelp forest (Figure 1). They examine the kelp forest food web (Figure 2). They also find some data about the effectiveness of two possible solutions to the decline of kelp forests (Figures 3 and 4).
<b><u>Possible Evidence</u></b> <ul style="list-style-type: none"> <li>Students develop a model in which they identify the components relevant to testing ideas about the designed system, including the following:               <ul style="list-style-type: none"> <li>The given problem being solved, including criteria and constraints</li> <li>The components of the given proposed solution (e.g., objects, tools, processes) including inputs and outputs of the designed system</li> </ul> </li> </ul>		

- Students identify and describe the relationships between components, including the following:
  - The relationships between each component of the proposed solution and the functionality of the solution
  - The relationship between the problem being solved and the proposed solution
  - The relationship between each of the components of the given proposed solution and the problem being solved
  - The relationship between the data generated by the model and the functioning of the proposed solution
- Students use the model to generate data representing the functioning of the given proposed solution and each of its iterations as components of the model are modified.
- Students identify the limitations of the model with regards to representing the proposed solution.
- Students describe how the data generated by the model, along with criteria and constraints that the proposed solution must meet, can be used to optimize the design solution through iterative testing and modification.

### Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

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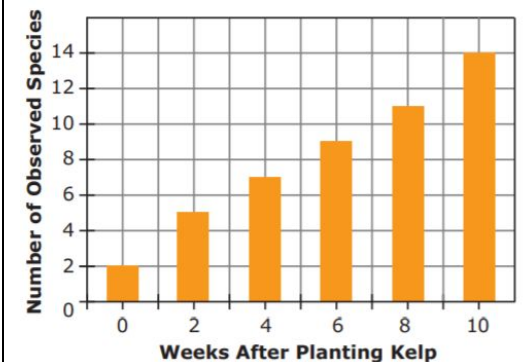


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D. Hire fish and wildlife officers to enforce sea bass capture limits

E. Gather signatures for a petition to pass laws that encourage kelp farming

**Solution Meets Criteria**

1. From the solutions above, choose the best solution and develop a model which explains how the solution will solve the problem.